Revitalization of High-End Computing

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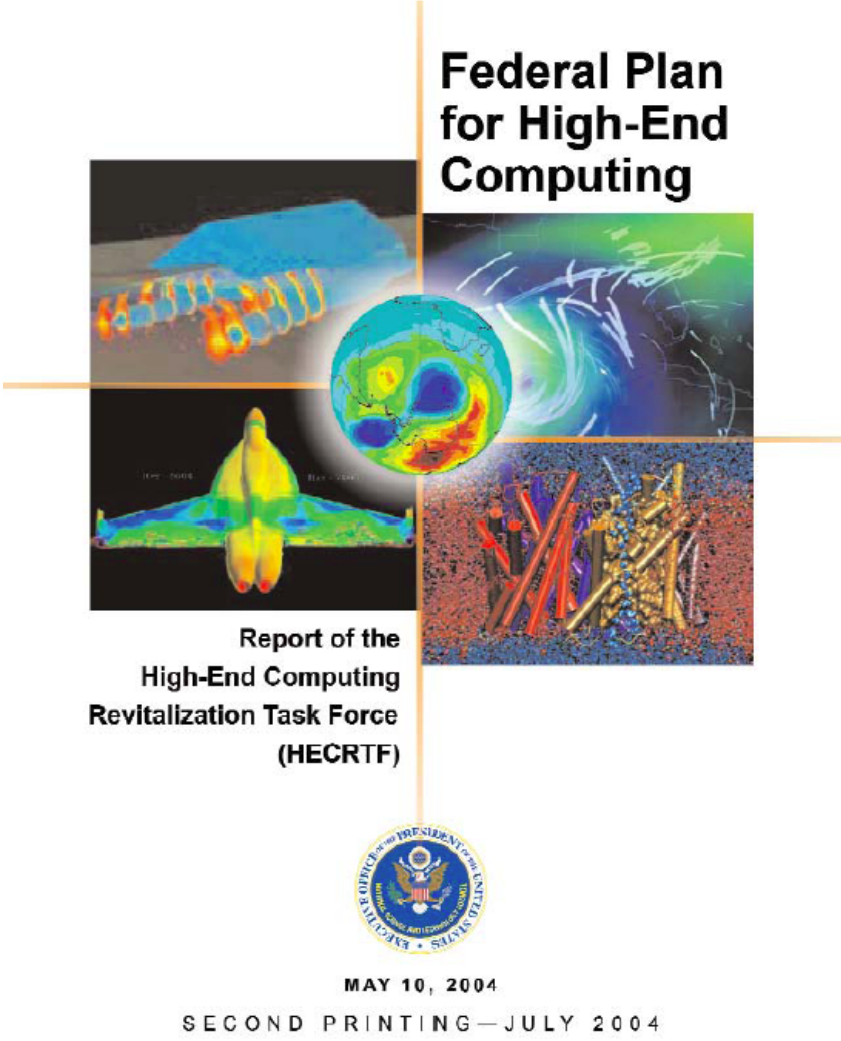
***Thanks to John Grosh for source material**

Current Status

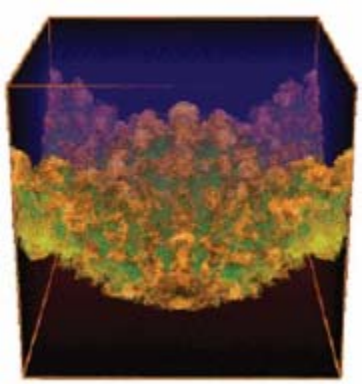
- ***Federal Plan for High-End Computing*** **released May 10, 2004**
- **What has happened since?**
- **This talk covers start of implementation.**



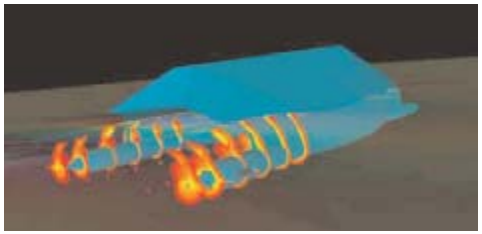
What was the High-End Computing Revitalization Task Force (HECRTF)?

- **Inter-agency planning group**
  - Develop 5-year plan/roadmap to improve how the Federal government develops, purchases, and provisions HEC
  - Participants include DoD (DARPA, ODUSD (S&T), HPC Modernization Program, NSA), DOE (NNSA and Science), EPA, NASA, NIH, NIST, NOAA, NSF, OMB, OSTP, NCO (approx. 60 people)
  - Focus on advancing agency/end-user needs in HEC
- **Established by OSTP, under the auspices of the National Science and Technology Council, in March 2003. Plan published May 10, 2004.**

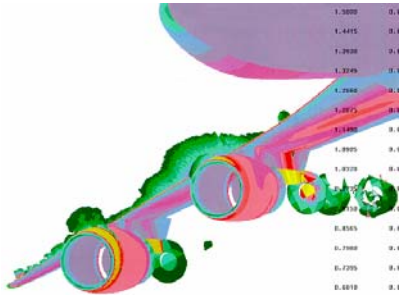
Applications of High-End Computing:
Big Problems with Big Impacts



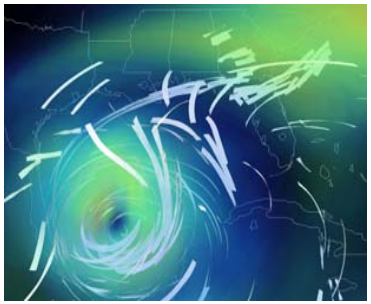
Nuclear Stockpile Stewardship



Ship Design

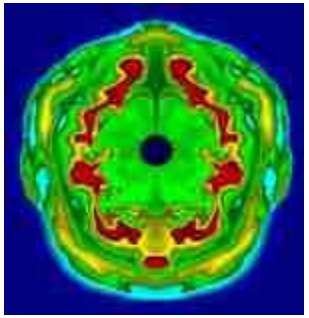


Aeronautics

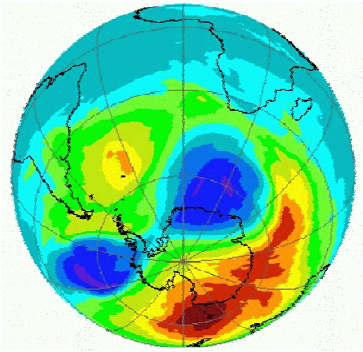


Weather Prediction

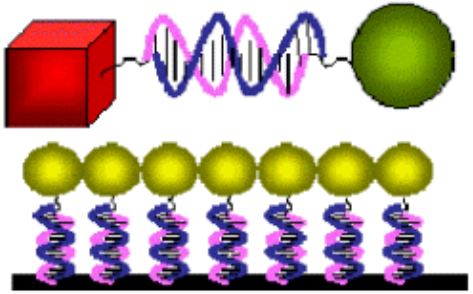
Cryptanalysis



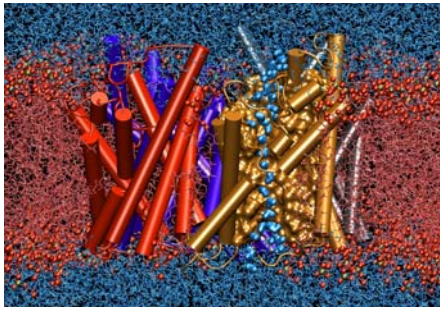
Astrophysical Simulation



Climate Modeling



Nano-Science



Biology

User and Agency Views on High-End Computing

- **Research pipeline dry**
- **Industrial base issues**
- **Technology improvement demanded by users**
  - Radical improvements in time-to-solution;
  - Significant improvements to system bandwidth, reliability, ease of programming
  - Diversity of architectures
- **User demand exceeds available resources for both capacity and capability**

HECRTF Goals

- Make high-end computing easier and more productive to use.
- Foster the development and innovation of new generations of high-end computing systems and technologies.
- Effectively manage and coordinate Federal high-end computing.
- Make high-end computing readily available to Federally Agencies that need it to fulfill their missions.

High End Computing Revitalization Plan in a Nutshell

	Elements	Major Challenges Addressed
R&D	• **Hardware, software, and systems roadmaps** • **Basic and applied research, advanced development, engineering and prototypes, and test and evaluation** – Research and evaluation systems – Life-cycle software strategy	• **Improve performance, programmability, usability, and reliability for Agency applications** • **Provide a range of robust HEC architectures and software technologies to address Agency requirements** • **Re-establish research pipeline** • **Ensure healthy research/tech/industry base**
Resources	• **Accessibility – Small / Large Agencies & Industry** • **Availability – Production Computing** • **Leadership – Largest systems for scientific leadership**	• **Lack of access to HEC resources by small agencies (e.g., NIST)** • **Increasing demands for HEC exceed resources** • **Large-scale systems to attack high-priority national problems**
Procurement	• **Pilot studies in benchmarking, total cost of ownership, and procurements**	• **Improve efficiencies in procurement for government and industry** • **Improve evaluation methodologies of HEC systems for procurements and systems designs**

OSTP-OMB Memo on FY06 Research Priorities

"Networking and Information Technology R&D

The Networking and Information Technology **R&D (NITRD)** program is a high Administration priority. While the importance of each of the NITRD program areas continues, high-end computing (supercomputing) and cyberinfrastructure R&D should be given higher relative priority due to the potential of each in furthering progress across a broad range of scientific and technological application areas. The recent report of the High-End Computing Revitalization Task Force (HECRTF) describes a coordinated R&D plan for core high-end computing technology, as well as multi-agency approaches for addressing high-end computing capability, capacity, and accessibility issues. Agency plans in high-end computing should be consistent with the HECRTF plan, emphasize coordination, leverage the efforts of all agencies and, where appropriate, provide explicit benefit to multiple agencies through coordinated multi-agency investments."

http://www.ostp.gov/html/m04-23.pdf

High End Computing University Research Activity (HECURA)

- **Coordinated Solicitations**
  - NSF, DOE/Office of Science, DARPA
  - Working group chair: Candy Culhane (NSA)
- **ITRD Portal**
  - http://www.itrd.gov/hecrtf-outreach/hec-ura/index.html

HEC R&D Area	Lead Agency
Operating systems	DOE/Office of Science
Languages, compilers, and libraries	National Science Foundation

(Proto) Leadership-class Systems

- **NASA Project Columbia**
  - **Partnership with SGI and Intel**
  - **Cluster of 20 interconnected SGI® Altix® 512-processor systems; 10,240 Itanium 2 processors**
- **DOE Leadership-class system at ORNL**
  - **20 TF Cray X1 + 20 TF Cray Red Storm growing to 100TF in 2006**
- **DOE and NASA discussing possibility for coordinated availability of resources to community**

Augmentation of HPCS Program

- Several agencies working with DARPA
  - NASA, NSF, NSA, NRO, DOE/NNSA, DOE/SC, DOD/HPCMP
- Emphasizing performance characterization and software productivity
  - HPC Challenge

HEC System Performance Assessment

- Rationalize federal performance assessment activities beyond current HPCS activities
- Likely invite companies to participate
- Slightly slow start, but first workshop held
- Lead: Bryan Biegel, NASA
- Goals: better assessment to
  - Aid procurement decisions
  - Aid computer design decisions
  - Better match codes to available computers
  - Assess whether expected performance is being achieved.

Agency-Industrial Partnerships

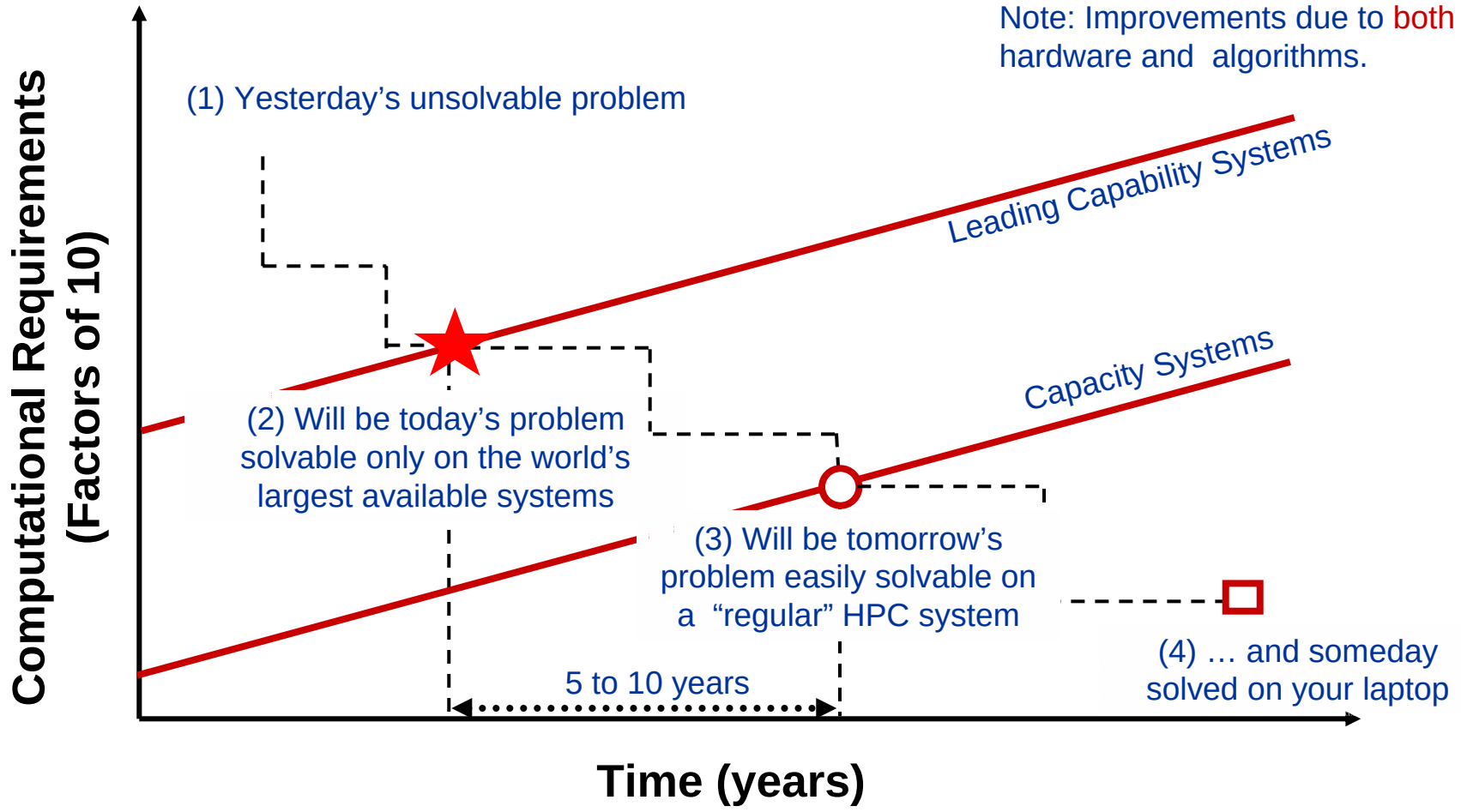
- Purpose: to bring together agencies and companies interested in application area
  - Possible examples: combustion, structures, CFD
- Organized jointly by Council on Competitiveness (CoC) and NITRD program
- Outgrowth of Council HPC workshop last summer
- Process:
  - NITRD agencies selecting areas of interest
  - CoC will seek industry interest
  - Future joint meetings to define projects
- Could involve substantial computer resources

Conclusions

- HECRTF plan released May 10, 2004
- Several early-start activities already underway
  - OMB/OSTP policy endorsement
  - HECURA
  - (Proto) Leadership-Class Systems
  - Augmentation of HPCS
  - System Performance Assessment
  - Industrial Partnerships
  - Assessment of Japanese High-End Computing
- FY06 will be first opportunity for significant additional implementation

Backup

Transition of Solving Important Problems



High-end computing enables US to solve "unsolvable" problems first.